

**TIIAP FY 1999**  
**Project Narrative**

Sevier River Water Users Association

Grant # 49-60-99039  
Community Networking  
Delta, Utah

## **EXECUTIVE SUMMARY**

### **Sevier River Basin - Water Resource Management Network**

The proposed TIIAP project is intended for the “Community Networking” primary application area and the “Education, Culture, and Lifelong Learning” and “Public Safety” as secondary application areas.

The goals of the project are to: (1) improve the economy in the Sevier River Basin (Basin) by enhancing natural resource management; (2) improve public safety by providing more timely emergency information; and (3) enhance cultural resources and lifelong learning opportunities.

The project will be evaluated by examining the use rates on the project’s interactive web site (*water.gbasin.net*), interviewing end users, and conducting an evaluation of the network applications by an international authority in water resource management.

The proposed TIIAP project would enlarge and tie together diverse real-time data collection systems into a comprehensive network. The project would ultimately interconnect over 40 data collection and automation sites, a main webserver site, 2 river commissioners, all canal companies, many of the major irrigators, and numerous secondary and tertiary data users. The data will be dispensed (and additional data collected) over the Internet.

The technologies involved include: (1) low-cost, solar-powered river, canal, and reservoir automation; (2) secure communication networks (primarily wireless); and (3) interactive real-time web sites.

The water users will use the technology to better manage their farms and water supplies, to improve emergency response capabilities, to assist local groups promoting tourism, to improve understanding of the history of the local water resource developments, and to share data with secondary and tertiary users.

Areas to be served include the following rural Utah counties: Garfield, Piute, Sevier, Sanpete, and Millard.

The sponsor of the project is the Sevier River Water Users Association. Partners include: Utah State University, University of Utah (Utah Mesonet), Utah Climate Center, Upper and Lower Sevier River Commissioners, National Weather Service, Bureau of Reclamation, individual canal companies, etc.

## **PROJECT NARRATIVE**

### **Sevier River Basin - Water Resource Management Network**

**Project Definition:** The proposed project would develop a comprehensive real-time (actually it is “near real-time” but for the sake of simplicity, the term “real-time” will be used in this proposal) water monitoring and control network and use the Internet to communicate with the various end users. This interactive water management network would be developed and demonstrated in the Sevier River Basin (Basin), but any innovation could be easily transferred to other watersheds throughout the United States and the world.

The management of water is becoming increasingly critical in various parts of the United States, particularly the West. In the past, western water management was synonymous with constructing such features as storage reservoirs, pipelines, aqueducts, diversion dams, irrigation canals, and flood detention basins. But since the most cost-effective water projects have already been built and since environmental restrictions make new construction unlikely, new methods of managing water resources have become a necessity.

Real-time monitoring and control networks have shown great potential for enhancing river operations and improving local economies. With better and lower-cost computer and communication equipment on the market, real-time networks are cost-effective for almost any water user group. More timely and accurate information, coupled with low-cost automation, leads to better decision-making. A water manager at his computer can be connected to water monitoring and control sites throughout the watershed, and can react almost immediately.

**Sevier River Basin.** Numerous studies, national commissions, and committees have concluded that a river basin is the ideal water management unit. The Sevier River Basin is a large, self-contained watershed in central Utah (see Appendix A). It is rural in character and sparsely populated, having 12.5 percent of the State’s land mass but less than 2 percent of its population. In 1997, the Basin had a total population of 57,000 and Richfield, the Basin’s largest community, had 7,500 residents. Critical to the economy of the Basin is irrigated agriculture. And critical to the success of irrigated agriculture is a reliable water supply. Both overwatering and underwatering leads to reduced crop yields, and overwatering brings water quality problems..

Other economic factors such as tourism are becoming increasingly important to the Basin’s economy. Bryce Canyon National Park is located in the Basin, as are several State parks. Around the Basin are several other scenic attractions including: Great Basin National Park,

Capital Reef National Park, Zions National Park, Cedar Breaks National Monument, and the newly-created Escalante-Grand Staircase National Monument. Additionally, the Basin's reservoirs--Panguitch Lake, Otter Creek Reservoir, Piute Reservoir, and Sevier Bridge Reservoir-- attract tourists and sports enthusiasts.

**Sevier River Water Users Association.** The Sevier River Water Users Association, incorporated in 1960 as a non-profit organization, is responsible for operating the Sevier River. The Association is governed by a River Board, with representatives from all areas in the Basin, which has the authority to levy assessments to offset the costs of operating the river.

**Existing Real-Time System.** In 1993, the Sevier River water users started working with automation and real-time technologies. Dr. Wynn Walker, at Utah State University (USU), worked on a successful low-cost canal automation project in the lower Basin. The Bureau of Reclamation (Reclamation) is working on a real-time monitoring and control system in the central Basin (the area around Richfield). In addition, the U.S. Geologic Survey (USGS) operates seven real-time streamgauging stations using GOES (satellite) communication. The real-time systems in the Basin include: 3 automated water storage dams; 2 reservoir monitoring stations; 8 automated diversion structures; 11 canal monitoring stations; 9 river monitoring sites; and 2 weather stations.

Until 1997, the distribution of real-time information was limited to a few water managers. At that point, Bret Berger (StoneFly Technology) approached the central Basin water users about setting up a web site to dispense real-time information over the Internet. This proposal was accepted and work was begun on a site: *water.gbasin.net* (see Appendix B for examples of the web pages). The site, which updates hourly, proved to be highly very successful. Many water users in the Basin were encouraged to get connected to the Internet. This trend is expected to continue.

Water users in the central Basin quickly realized they had barely grazed the surface of what is possible with their web site and the remainder of the Sevier River water users wanted the network expanded to include the entire Basin.

**THAP Proposal.** The proposed project would develop *water.gbasin.net* into a full-fledged water management and economic development tool. Improvements and innovations would include: (1) integrating all existing real-time systems into one comprehensive network; (2) enlarging the network to include the entire watershed (it now only encompasses the central Basin); (3) constructing a appropriate relational database; (4) developing a program whereby all canal companies can place water orders over the Internet; (5) incorporating real-time water balances to help quality control data and estimate unmeasured inflows (i.e., agricultural return flow, perennial streams); (6) installing a reliable call-out alarm system; (7) daily water rights updating to provide the current status of individual rights; (8) developing a secure communication system for Internet control applications; (9) evaluating basin-wide river operations models to optimize water deliveries; and (10) providing an irrigation scheduling

program, using data from weather stations, to maximize crop production. The project would also fine-tune the web site to better meet the needs of secondary users.

During 1999, the Sevier River Water Users Association is committed to installing all the field stations necessary to complete the data collection and automation requirements for extending *water.gbasin.net* to the entire Basin.

**Outcome.** Several outcomes are expected from the project including: (1) improved water management through better timing of water deliveries; (2) water conservation; (3) better crop yields; (4) enhanced tourism; and (5) improved public safety.

## Evaluation

**Web site Statistics.** The current web site, designed by StoneFly Technology, keeps detailed web site use statistics (see Appendix B). At the start of the project, this section of the web site would be reviewed, and upgraded if necessary. At all review points and in all project documentation, web site use rates would be reported. In addition, 2 independent evaluations of the network would be made:

**End-User Input.** At the mid-point and conclusion of the TIIAP project, Ms. Sydne Jacques would interview all the principal users of *water.gbasin.net* and determine: (1) their use of the system; (2) their recommendations for improvements; and (3) specific benefits derived from using the system. If the number of potential interviewees is too large, a random sample will be taken. (The project's technical consultant is experienced with survey techniques and statistical evaluations.)

**Review of Science and Technology.** At the mid-point of the TIIAP project, Dr. Trevor Hughes would review the science and engineering associated with *water.gbasin.net* to ensure the technical adequacy of the system and make recommendations as to how it could be improved. .

## Significance

**Describing the Innovations.** The existing real-time monitoring and control system in the central Basin involves a standard field site: (1) datalogger/controller (on-site computer); (2) radio modem; (3) telemetry radio; (4) solar power; and (5) a variety of sensors and actuators (depending on the function of the site). Information is then telemetered back to a radio-to-telephone interface. The data is then available to anyone with a computer equipped with a telephone modem (and with the access codes). So as not to tie up the telephone lines, the data is posted on the Internet hourly. (Only those managers directly involved in operating the river now use the telephone lines.)

The Sevier River Water Users Association, StoneFly Technology, and Reclamation have been developing a low-cost prototype for posting live images on their web server. To do this they have installed a computer with a Linux operating system at a field site. The field unit is a fully functional Internet web site. To get the image back to the web server, a spread-spectrum radio

communication system is used. The same system could be used to control a gate or other water control device, but some form of secure communications (i.e., encryption) will be required.

In addition, the water users have also been experimenting with wireless connections to their Internet Service Provider (ISP). A wireless connection would allow water managers mobile access to their web site (they would not be tied to telephone lines). They would also have faster Internet service.

In the past, monitoring and control of water systems has been by SCADA (supervisory control and data acquisition) systems. Because of the multi-million-dollar costs of SCADA systems and their proprietary nature, they are only used by a few wealthy water districts. But with the advent of low-cost dataloggers, computers, and telemetry systems (plus the rapid growth in Internet technologies), the benefits of real-time monitoring and control are now available to all. But first the technologies need to be configured to meet the needs of local water users and economic planners. This TIIAP proposes to do just that.

***Establishing a Model Project.*** Any innovations could be readily transferred to other watersheds throughout the United States and the world.

## **Project Feasibility**

***Technical Approach.*** The basic approach of the TIIAP project will be to tie all the real-time systems in the Basin into a comprehensive, interactive system using the existing *water.gbasin.net* web site. Where possible this will be accomplished through electronic data transfer. In addition, the needs of secondary and tertiary users of the network will be accommodated.

Once a comprehensive network has been set-up, software will be developed to provide decision-making support to water managers and other users. The real-time data from the field sites will drive these models. This information, along with the real-time data, will be available on the Internet. The software will include, but not be limited to water rights, river operations, irrigation scheduling, and forecasting.

Additionally, communication innovations will also be integrated into the system. They include: wireless ISP connections, live images, field web sites, call-out alarms, and secure Internet communications for control applications.

Because of the way the real-time data network is designed, new field sites can easily be added. The web site will also be designed to handle an expanding system of field sites and end users.

Alternatives to the above approach include: (1) constructing new water control facilities and (2) installing full-scale SCADA systems. For the reasons discussed above, neither is practical nor cost-effective.

***Applicant Qualifications.*** The Sevier River Water Association is committed to including a mix of water users, consulting engineers, academics, scientists and researchers, and network integrators on the project. Those currently committed to the project include the following:

Dean Anderson, project fiscal agent, is the secretary-treasurer of the Sevier River Water Users Association and office manager for the DMAD Canal Companies in the lower Basin. Mr. Anderson would handle day-to-day operations and be the project's principal contact point with NTIA.

Bret Berger is designing and setting up the web site (which dispenses real-time meteorologic and hydrologic information) currently being used by the central Basin water users. Mr. Berger runs his own computer and communication consulting firm--StoneFly Technology--and has a B.S. in Electrical Engineering. He would be responsible for the design and construction of the expanded web site. He would be the project's system integrator, including all communications systems.

Roger D. Hansen, Ph.D., would be the technical coordinator on the project. He is an activity manager in the Provo Area Office of Reclamation, who has wide experience with water management in the Sevier River Basin. Dr. Hansen has overseen the installation of irrigation automation projects throughout the United States. His participation would be off budget.

Trevor Hughes, Ph.D., would be a project evaluator. He is a retired professor from USU with an international reputation in water resources and hydrology. He currently runs his own consulting firm.

Sydne Jacques would also be a project evaluator. She has a B.S. in Civil Engineering and is an experienced interviewer. She currently runs her own consulting firm and is uniquely qualified to review the project.

Donald T. Jensen, Ph.D., is the Utah State Climatologist and professor at USU (see Appendix C). He operates a network of weather stations in the Basin which would be integrated into the water management Internet system. Dr. Jensen would work on the real-time displays for weather data, irrigation scheduling software, and coordinate all weather/climate related activities.

Ray Owens and Jim Walker are the Upper and Lower Sevier River Commissioners. They would assist with the design of the Basin web site and are important end users of the real-time network.

Roger Walker, retired, a life-long resident of the lower Basin, served for over 20 years as the Lower Sevier River Commissioner. He would serve as a consultant on water rights, water management in the Basin, and the history of water resource development.

R. Wynn Walker, Ph.D., head of the Department of Biological and Irrigation Engineering Department at USU, has an international reputation in irrigation engineering, and has published widely (see Appendix C). He has been the principal investigator on several projects in the Sevier River Basin, including (1) documenting water rights administration in the Basin; (2) computerizing the algorithms for computing water rights allocations; and (3) demonstrating canal automation projects in the lower Basin. Dr. Walker would be responsible for updating the water rights administration software to provide a daily update.

A partial list of organizations participating or cooperating in the project would include the individual Sevier River canal companies, USU, Utah Climate Center (at USU), University of

Utah (Utah Mesonet), Utah Division of Water Rights, Reclamation, National Weather Service, and Utah Division of Comprehensive Emergency Management.

***Budget, Implementation Schedule, and Timeline.***

The budget for the project would be:

	<u>FY2000</u>	<u>FY2001</u>	<u>FY2002</u>	<u>Total</u>
Federal	\$135K	\$135K	\$135K	\$405K
Sevier River WUA et.al.	<u>135K</u>	<u>135K</u>	<u>138.6K</u>	<u>408.6K</u>
	\$270K	\$270K	\$273.6K	\$813.6K

Specific tasks to be accomplished include:

1. Organize steering committee & finalize Plan of Study Nov 99 Anderson, Hansen
2. Final basic design for interactive network Dec 99 Berger
3. Complete installation of the basic Basin-wide monitoring and control system Dec 99 Various
4. Integrate all real-time systems into a comprehensive web site Mar 00 Berger
5. Develop software for placing water orders over the Internet Mar 00 Berger
6. Develop daily water rights model for lower river Mar 00 Walker
7. Install two additional web servers/file servers Mar 00 Berger
8. Develop concept for river operations model Jun 00 Walker, Hansen
9. Develop secure communications for possible control of water structures over the Internet Sep 00 Berger
10. Develop daily water rights model for upper river Mar 01 Walker
11. Develop real-time water balance for Internet Mar 01 Berger, Hansen
12. Evaluation at the mid-point Sep 01 Jacques, Hughes
13. Develop irrigation scheduling software Sep 01 Jensen
14. Complete river operations model Jun 02 Walker, Hansen
15. Final evaluation Jul 02 Hughes, Jacques
16. Final report/video Sep 02 Various

Additional subtasks would be ongoing throughout the project's life. For example, certain sections of the web site would be enhanced to include real-time displays related to public safety (dam safety, flooding, drought, and, landslides), tourism (reservoir levels, river conditions, and weather) and the history of water resource development in the Basin.

***Sustainability.*** The Sevier River Water Users Association was officially incorporated as a non-profit organization in 1960 and has successfully operated the river through the river commissioners since. The Association will assume the responsibility for maintaining the

innovations developed during this project.

Training will be important to the long-term sustainability of the project. Every year of the project a multi-day training session for the end users will be held.

The web site, *water.gbasin.net*, will contain the necessary information to maintain the equipment. The site already has a list of equipment manufacturers and vendors. Additional information and troubleshooting suggestions would be included on the web site. As much as possible, the network would be designed to be self-diagnosing.

## **Community Involvement**

***Partnerships.*** As already noted, the Sevier River Water Users Association has had long-term relationships with several entities including USU, USGS, Utah Division of Water Rights, and Reclamation. Lately the number of partnerships has grown substantially.

Recently *water.gbasin.net* came to the attention of the National Weather Service (NWS). NWS staff asked about the possibility of adding weather sensors at several stream-flow data collection sites and then electronically transferring the data.. This would help fill holes in NWS's real-time weather gathering network. This partnership was readily agreed to. Using sensors provided by the Utah Climate Center (USU), two weather stations were added to *water.gbasin.net*. This data is electronically transferred hourly to Utah Mesonet (a real-time database/web site at the University of Utah (U of U)) where it is available to NWS and daily to the Utah Climate Center. With improved real-time data sets, NWS will be providing more accurate forecasts for the Basin.

After discussions with USU, U of U, NWS, Utah Climate Center, and others, it became apparent that there were a number of important potential secondary users of the Basin's interactive network including researchers, boaters, fishermen, weathermen (the Weather Channel has been hitting the site), and tourists. The Sevier River Water Users Association is committed to pursuing all viable partnerships.

***Involvement of the community.*** Presentations will be made annually to the River Board and general meeting of the Sevier River Water Users Association. In addition, the web site will be used to solicit involvement from all groups. All project reports would be posted on the Internet.

***Support for end users.*** Annual training sessions will be held for all end users. The training would be a joint effort of the Sevier River Water Users, USU, Federal and State agencies, and vendors/manufacturers. During the evaluation process, training needs of the end users will be carefully considered.

***Privacy.*** At all stages of the project, the issue of privacy will be considered. Most of the information on the network is of a general and public nature, so no strong issues are anticipated. Should privacy issues surface, the staff has the technical ability to get them resolved and to

protect private information.

### **Reducing Disparities**

The Basin is a sparsely populated rural area located well away from Utah's highly populated Wasatch Front (Salt Lake City and the surrounding areas). Richfield is the largest city in the Basin and it has a population 7,500. Farming in the Basin is a family operation. Nobody is getting rich farming, but agriculture is an important part of the Basin's economy.

This project represents an environmentally sound and viable option for improving the quality of life and local economy. The proposed network will improve crop yields (by providing a more reliable water supply), conserve water, and enhance tourism. It will also improve the Basin's ability to respond to some emergencies.

### **Documentation and Dissemination**

**Documentation.** At the end of the 3 years, a 20-minute video describing the project will be produced. The video will be a combination of technology descriptions and interviews with end users. (It may be that in 3 years it will be more appropriate to produce a CD-ROM or DVD presentation.) Dr. Hansen has considerable experience with producing multi-media presentations.

All reports and documents (including the evaluations) generated during the life of the project will be posted on the Internet site and the site will continue to be heavily promoted.

**Dissemination.** Dr. Hansen, Dr. Walker, and Dr. Jensen all routinely attend professional conferences. Each will present at least one paper concerning the technological and institutional innovations of the project. This will be done at little cost to the project. In addition, the web site will be promoted in the newsletters of professional societies. (The web site is currently being hit by individuals and organizations from around the world, so wide dissemination of all information is anticipated.)